

Contract R&D services in fire safety

...are offered by *Fire Science and Technology Inc.*

What is Fire Science and Technology Inc.?

FSTI is a firm specializing in fire science, contract R&D, fire litigation support, assistance in the development of products with improved fire safety, and related subjects. It is headed by Dr. Vytenis (Vyto) Babrauskas.

What are the FSTI services offered in the R&D area?

FSTI offers to product manufacturers, research institutions, governmental entities and others a complete line of contract R&D services in the fire safety area. These include formulation and management of research programs, technical assistance with product development, and various aspects of fire testing.

Specialties

- Management of research and development programs in the fire safety area.
- Assistance to manufacturers with fire test standards and requirements.
- Development of code change proposals and technical backups for variance requests.
- Fire hazard analyses.
- Assistance to exporters and importers with foreign fire safety requirements.
- Assessments of product combustion toxicity and corrosivity.
- Computer fire modeling.
- Scientific analyses of fire behavior in connection with reconstruction of fire incidents.
- Assessments of effectiveness of fire retardancy and of fire performance of plastics and composites.
- Development of new fire safety design concepts for unusual applications.
- Training seminars, lectures, custom-designed educational offerings.

[*Note:* FSTI does not provide routine fire protection services, such as design of automatic sprinkler and fire alarm systems, fire safety audits, etc.]

Capabilities

Fire Science and Technology Inc. is headed by Dr. Vytenis (Vyto) Babrauskas. Dr. Babrauskas was the first ever person to be awarded a Ph.D. degree in Fire Protection Engineering. For more than 16 years he headed up numerous fire research programs and projects at the National Institute of Standards and Technology (NIST). In 1993 he organized FSTI to make available some advanced fire safety expertise to a commercial clientele.

Experience

The clients of FSTI are offered expertise drawing upon the extensive fire safety experience of Dr. Babrauskas, which includes:

Developed the first-ever U.S. computer fire model (COMPF) in 1975.

Invented the Cone Calorimeter, which is now an ASTM standard (E 1354) and has been adopted by many countries and by the International Organization for Standardization (ISO 5660). This was the first fire test method to be awarded the prestigious *R&D 100* award.

Invented the furniture calorimeter. This has formed the basis for the current-day standard practice in measuring the heat release rate of furniture and other commodities. It is referenced in numerous ASTM, UL and foreign standards.

Developed procedures which led to the first comprehensive, systematic fire hazard analysis to be conducted, based on full-scale and bench-scale testing (for FRCA).

Pioneering technical leadership in quantifying furniture flammability and its measurement. This was described in a NIST monograph. More recently, provided extensive technical guidance to the European CBUF research program, which was completed in 1995 by a consortium of 11 laboratories. This has led to a new generation of furniture fire models.

Developed the first standard for the exchange of fire test data in computer file form (FDMS). This is now being used by a number of laboratories, instrument manufacturers, and fire models.

Extensive experience with International Standards, serving as a U.S. Assigned Expert. Also, U.S. Technical Representative to the ongoing Japanese program leading towards the development of a performance-based building code for Japan.

Produced the first comprehensive state-of-the-art assessment of flammability test methods for electric wire and cable (for NEMA).

Invented the laser smoke photometer, now commonly used in bench-scale, intermediate scale, and large-scale fire tests.

Headed the NIST team to develop a new-generation fire toxicity test. Developed the technology for the necessary CO predictions in order to extend test applicability to post-flashover fires.

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Support and expert witness services for fire investigations and litigations

...is offered by *Fire Science and Technology Inc.*

Why do fire investigators, attorneys, and insurance companies need fire safety science expert help?

Despite the fact that it is a common, everyday phenomenon, fire is a very complex chemical, physical, and thermal event. When it comes to an unwanted fire, it is often important to answer questions such as: *What exactly happened?* or, *Why did the fire get so large?* or, *If this product were made differently, would this have affected the outcome?* These questions are usually difficult to answer and opposing parties tend to disagree. The personal experience of the fire investigator will be essential to define these questions and to begin answering them. Yet, even decades of experience can only give qualitative answers, whereas often quantitative answers are required.

The role of the fire scientist is to start with the data and hypotheses of the fire investigator and then to harness scientific theories, models, and specialized tests in order to progress from a qualitative to a quantitative understanding of what actually happened.

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What are the unique strengths of FSTI?

Viewed very simply, the main tasks of the fire scientist are two:

- The commissioning, analyzing, and interpreting of fire tests
- The application of scientific/engineering formulas, equations, and computer models.

In both of these areas, all competent practitioners are able to apply the known principles and methods to the case at hand. However, Dr. Babrauskas has the distinction of actually having **invented** many of these methods.

- ***The commissioning, analyzing, and interpreting of fire tests.***

Dr. Babrauskas has nearly 25 years experience in developing fire test methods. He is the inventor of the **Cone Calorimeter** (ASTM E 1354; NFPA 264) and the Furniture Calorimeter (specified in UL 1056, California T.B. 133, etc.) His Ph.D. dissertation was on the subject of problems and uses of the fire resistance test, ASTM E 119. He was the main author of the first comprehensive state-of-the-art assessment of flammability test methods for electric wire and cable. He invented the laser smoke photometer, now widely used in various fire test methods, and has written extensively on issues involving the measurement of smoke in

fires.

- ***The application of scientific/engineering formulas, equations, and computer models.***

The first-ever computer fire model released in the U.S. was written by Dr. Babrauskas: COMPF (University of California, Berkeley, 1975). Since then, Dr. Babrauskas has contributed to the HAZARD I model of NIST, organized the fire modeling portions of the recent European research into furniture flammability (CBUF), developed a model for liquid pool burning, etc. He is one of the few individuals who have been actively developing fire modeling throughout the entire history of this specialty.

Relevant expertise in some areas pertinent to fire investigations

- ***Electrical fires***

Electrical fires are typically investigated in an empirical manner and systematic, scientific examination of this phenomenon has rarely been undertaken. Dr. Babrauskas has written several recent **papers** where he endeavors to place the understanding of ignition from electrical means on a systematic basis. The topic is also treated at great length in his **Ignition Handbook**. Much of the research in this field has been conducted in Japan and published only in Japanese; Dr. Babrauskas' papers and Handbook have made these results available for the first time in English.

- ***Ignition of fires and initiation of explosions***

One of the essential aspects of a fire investigation is to determine, if possible, the circumstances that led to ignition. Quite clearly, this objective would best be served by reference to an ignition handbook. In 1996 Dr. Babrauskas observed this situation and noted that no such reference tool was available. So over the next 7 years, with the encouragement of the Society of Fire Protection Engineers, he then undertook to develop an **Ignition Handbook**. This Handbook was published in 2003 and is a massive, unique tool for this purpose.

- ***Analysis of fire toxicity effects***

For a period of 6 years, Dr. Babrauskas headed up the toxicity research program at NIST. There, he finalized the radiant toxicity test apparatus, developed the first practical technique for quantifying carbon monoxide effects in fire tests, and developed a systematic engineering basis for treating fire toxicity effects.

- ***Determining how fast items could have been burning in a fire***

One of the most common issues to be determined in fire litigations is whether some item in question could or could not have been burning rapidly or excessively. Dr. Babrauskas is a leading authority on the subject of heat release rate. He invented the two fire test methods most commonly used today for determining "how fast things burn": the bench-scale **Cone Calorimeter** and the large-scale furniture calorimeter. He has also contributed chapters on this topic to both the **SFPE Handbook** (a comprehensive compilation of burning rates) and the **NFPA Handbook** (a detailed discussion of furniture fires). He is also the author of a textbook on this subject, **Heat Release in Fires**.

- ***Scientific analyses of fire behavior in connection with reconstruction of fire incidents.***

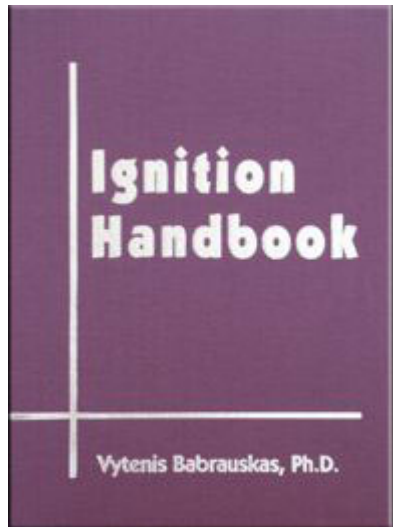
Dr. Babrauskas has authored numerous papers which present various engineering techniques for predicting fire behavior, including ignitability, flame spread, smoke production, and corrosivity of combustion products. These techniques are now in widespread use in the engineering community. Quantitative fire hazard analyses combining toxicity and fire growth variables are now commonly done. Dr. Babrauskas, however, was the first to provide a successful worked example of such an analysis. Such a wealth of experience allows him to speak authoritatively on the scientific principles of analyzing fire growth and development.

- ***Fire test methods***

Often, fire reconstructions are concerned with proper use of **fire test methods**. Dr. Babrauskas has been studying and developing fire test methods for some 25 years and is able to give advice on a very wide variety of test methods. This can be an important advantage, since many technical personnel have read descriptions of the test standards, but do not have a knowledge of their history nor an appreciation of their limitations. To have on your side an expert who intimately understands the foundations of these test methods can be a real advantage.

A GENERAL NOTE ON PROFESSIONAL BACKGROUND: **Dr. Babrauskas** was the first person to ever receive a Ph.D. degree in Fire Protection Engineering (University of California, Berkeley, 1976). He headed up fire test method development programs at NIST for a 16 year period. He is the author of over 250 papers on fire safety and is the U.S. editor for FIRE SAFETY JOURNAL.

Ignition Handbook



By Vytenis Babrauskas, Ph.D. Published by Fire Science Publishers, Issaquah WA, USA. Co-published by the Society of Fire Protection Engineers. ISBN: 0-9728111-3-3. List price \$198.00

After 7 years of preparation, the **Ignition Handbook** has now been published!

Even though ignition is the most important event in the course of a fire (no ignition: no fire), up until now there has not been a handbook devoted to this vital safety topic.

The Handbook is a massive resource, consisting of 1116 pages, tightly set in a 2-column, 8.5" x 11" (215 x 280 mm) format. The book includes 627 black-and-white figures, 447 tables, and 140 color plates. The Handbook is divided into two main sections: Chapters 1 through 13 include presentations of the fundamental principles of ignition sources and of the response of ignitable materials to heat or energy in various forms. Chapters 14 and 15 constitute an "encyclopedia of ignition," containing extensive

information on individual materials, devices, and products. Chapter 14 comprises alphabetically-arranged narrative descriptions of ignition properties and hazards for substances ranging from "Accelerants in incendiary fires" to "Zirconium." Chapter 15 contains database tables giving information on 473 pure chemical compounds and over 500 commercial or natural products, including such substances as dusts, fuels, lubricants, plastics, and woods.

For long life and ease of use, the book has been manufactured using the highest quality, traditional book production processes—the book is printed on acid-free paper, the pages are sewn (rather than glued together), and the book is bound in real cloth covers. Two placeholder ribbons are provided.

Fire safety is a truly interdisciplinary specialty and includes professionals working as fire protection engineers, fire investigators, fire safety scientists, loss prevention specialists, hazmat specialists, risk managers, insurance adjusters and SIU personnel, chemical process safety engineers, forensic scientists, and others. The educational backgrounds of these individuals will be diverse, especially as concerns their understanding of mathematics. Thus, a special approach was taken in preparing the **Ignition Handbook**: qualitative presentations and mathematical presentations are segregated into different sections in the book. The qualitative information will be of value to all fire safety professionals, while those without a good foundation in mathematics can omit the mathematical sections.

The Handbook will also be of interest to electrical engineers, since it is the first book to examine electrical fires from a systematic, comprehensive point of view. Much of the research on electrical fires has been done in Japan, and the **Ignition Handbook** contains the first English presentation for most of this work.

The Ignition Handbook treats in detail not just ignition of fires but also initiation of explosives and pyrotechnics and explosions of unstable substances. Ignition is defined as the "initiation of combustion" but many unstable substances react in ways where heat is produced by a non-combustion reaction, e.g., decomposition or polymerization. The scope of the Handbook includes the initiation of exothermic reactions in such substances. The sections that deal with hazardous materials

will be of special interest to workers in this field, because the Handbook endeavors to present ignition aspects in a more thorough way than can be found in existing monographs.

Sample pages of the book can be seen [here](#) (420K PDF). The complete table of contents can be seen [here](#) (132K PDF).

"The most comprehensive work on a single subject in the area of fire science. It is a tremendously impressive accomplishment, which has no peer in the area of fire science or fire protection engineering." **Morgan Hurley**, Technical Director, SFPE

"After publishing your book you have become a hero with the students in my lab (and with me!). Great book, amazing the amount of work that you put in it." **Prof. A. Carlos Fernandez-Pello**, U.C. Berkeley

"Forensic scientists usually concern themselves with the aftermath and residues of fires, so when an investigator asks how something might start a fire, or how long it would take, or what first fuel needs to be present, we draw a blank. This is the book we've needed - real data and reliable explanations for all manner of ignition mechanisms, rather than conjecture and misinformation." **John D. DeHaan**, consulting criminalist/forensic scientist

"The Ignition Handbook will be one of the most useful resource books in our library. In addition to truly interesting material in the rest of the book, Chapter 14 ('A to Z'), is an incredible range of information about 'hot topics' for fire investigators. It's all there in one resource, and it's a resource every serious fire investigator will want to own." **Jack L. Sanderson**, Editor, Fire Findings

"This Handbook is a tremendous source of information on many aspects of fire and explosion science, including many not usually included in standard books on this subject. It will be a very useful addition to the technical library." **Stanley Gossel** and **Laurence Britton**, Journal of Loss Prevention in the Process Industries

"This is certainly the definitive 'magnum opus' on the science of ignition of fires and explosives. It is the first major book on this topic and is outstanding in depth, comprehensiveness, clarity, and scholarly detail. An interesting feature of the book are color photos from actual fires, also various types of explosions. Very helpful in diagnosing fire and explosion events. Throughout the book there are also a large number of well-printed black-and-white diagrams and graphs. A substantial chapter covers pyrophoric materials and chemicals prone to runaway exothermic reactions. A long chapter, practically a book in itself (269 pages), consists of an alphabetized set of topics, A to Z, dealing with the ignition characteristics of many specific substances, manufactured articles and devices. Some topics discussed in unusually thorough detail include ignition by many kinds of electrical malfunctions, microwaves, eddy currents, lightning, friction, burning brands, and many others." **Prof. Ed Weil**, Polymer News

"This is a must-buy book for anyone who takes fire science seriously. The material is critically evaluated, synthesized, and distilled into a coherent view of ignition phenomena. It is a remarkable book and a major contribution." **Craig Beyler**, Fire Technology

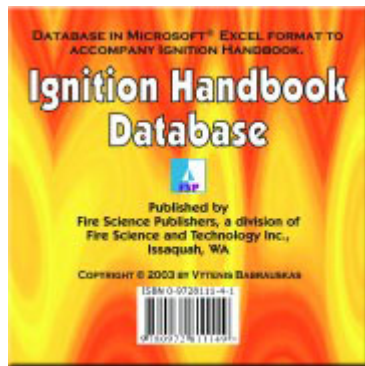
"I do not recall having seen in recent years a book of such magnitude. The author presents fundamental science relating to combustion, which is presented in a manner suitable for beginners with only a rudimentary understanding of chemistry, then expands upon this treatment at a level that would be suitable for the most advanced experts in areas relating to ignition of fires and explosions." **Prof. Gary Bennett**, Journal of Hazardous Materials

"This book is a must...since, in a very comprehensive way, it covers all aspects of ignition. After describing the fundamentals of combustion, it then addresses, chapter by chapter, the ignition of gases and vapours, dust clouds, liquids and solids. Significantly, it also has very useful chapters on self-heating, one on explosives and pyrotechnics, and one on preventative measures. Chapter 9 on

self-heating (75 pages of double-column text) is really a book in its own right...Shows a remarkable understanding in the summaries and descriptions for each area." **Prof. Andy McIntosh**, Trans.
ICHEME - Process Safety and Environmental Protection

For our special online offer, click [here](#).

Ignition Handbook Database (CD-ROM)



By Vytenis Babrauskas, Ph.D. Published by Fire Science Publishers, Issaquah WA, USA. ISBN: 0-9728111-4-1. List price \$60.00

Available for purchase separately is the **Ignition Handbook Database**. For convenience of users, much of the tabular material contained in Chapter 15 of the Handbook is made available in the form of a CD-ROM. Data tables in this CD-ROM are provided in the form of Microsoft® Excel spreadsheets. This allows easy access to information and also permits users who wish to seek to discover new data correlations to do this conveniently. Users must have Microsoft® Excel 97, or later version (or else a compatible spreadsheet program). The database tables provide information on 473 pure chemical compounds and over 500 commercial or natural products, including such

substances as dusts, fuels, lubricants, plastics, and woods.

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